FUTURE OF THE COGENERATION MARKET IN EUROPE

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- AVALABLE TECHNOLOGIES
- ECONOMICS
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TYPES OF COGEN-PLANTS

- Municipal cogeneration plants
  - cogenerate hot water
- Industrial cogeneration plants
  - cogenerate steam and hot water

•AVAILABLE TECHNOLOGIES

• Steam turbines	10 - 700 MW
• Combined cycles	50 - 700 MW
• Gas turbines	0,1 - 300 MW
• Diesel Engines	0,01 - 50 MW
• Gas or Dual-Fuel Engines	0,003 - 15 MW

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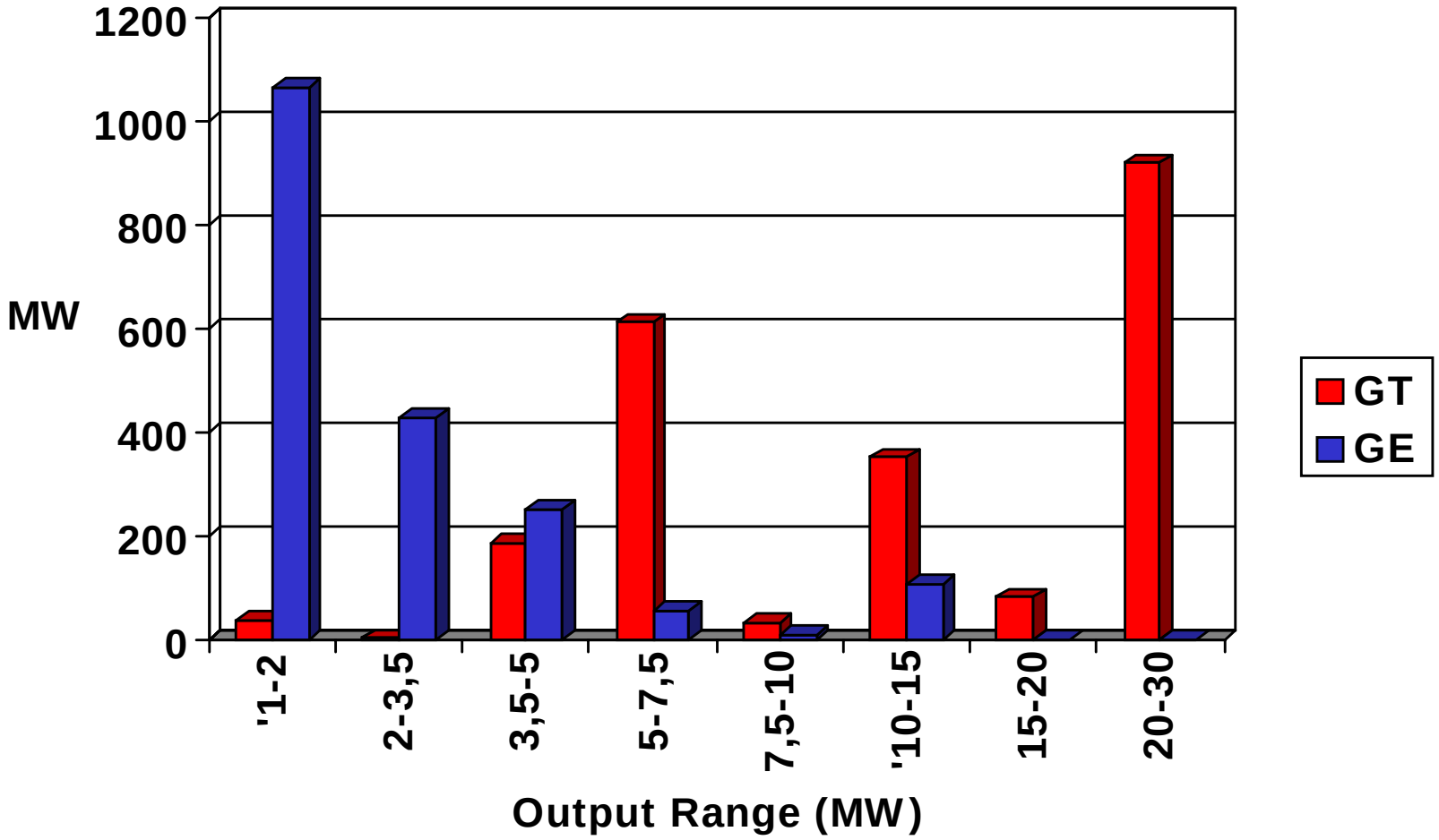
1-30 MW Gas Power Plant Market

Gas Turbine and Gas Engine Orders, June 1998-May 1999
Gas and Dual Fuel



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PRIMARY SELECTION

- FUEL AVALIABILITY
  - Coal and biomass = steam turbine plants
- GAS AND OIL PLANTS BY SIZE
  - LARGE > 60 MWe GTCC
  - MEDIUM 30-60 MWe Gas turbines
  - SMALL 1-30 MWe Gas engines
  - MINI 0.1-1 MWe Gas engines
  - MICRO < 0.1 MWe GE and Fuel Cells

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3 x 4 MWe PURE ENERGY PLANT IN GOTHENBURG SWEDEN

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3 kWe Gas Engine Home Power Plant

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ECONOMICAL EVALUATION

- Industrial chp-plants are most profitable
  - higher electricity price on-site+30-50 %
  - selling the heat + 30 % more revenues
  - more hours (5000-8000 h/a)
- Specific investment independent from size
  - lower output higher rpm

MARKET POTENTIAL

- Finland
- Sweden
- Denmark
- Germany
- OECD Europe

FINLAND TODAY

- Low electricity prices (at 10 GWh)
  - 40 E/MWh with taxes and transfer costs
  - separate transfer tariff = 20 E/MWh
- No subsidies, no special tariffs for cogen
- Several cogen plants are planned
  - Industrial 600 MWe
  - Municipal 200 MWe

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FINLAND, MARKET POTENTIAL

- Municipal Cogen plants
  - Output 3360 MWe
  - Generation 13.0 TWh
  - 20 % of generation
  - 43 % of municipal consumption (30 TWh)
  - 1000 MW potential to 50 % market share
- Industrial Cogen Plants
  - Output 2360 MWe
  - Generation 12.0 TWh
  - 18 % of generation
  - 28 % of industrial consumption (43 TWh)
  - 2000 MWe potential to 50 % market share

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SWEDEN TODAY

- Very low electricity prices (at 10 GWh)
  - 40 E/MWh with taxes and transfer costs
  - separate transfer tariff = 20 E/MWh
- Fossil fuels have very high taxes, no special tariffs for cogen
- Gas network needed in Central Sweden
- Capacity problems foreseen

SWEDEN, MARKET POTENTIAL

- Municipal Cogen plants
  - Generation 5.1 TWh
  - 3 % of generation
  - 6 % of municipal consumption (82 TWh)
  - 7200 MWe potential to 50 % market share
- Industrial Cogen plants
  - Generation 4.4 TWh
  - 3 % of generation
  - 8 % of industrial consumption (58 TWh)
  - 5000 MWe potential to 50 % market share

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DENMARK TODAY

- Low electricity prices (at 10 GWh)
  - 52 E/MWh with taxes and transfer costs
  - separate transfer tariff = 10-20 E/MWh
- Fossil fuels have very high taxes
- Subsidies for cogen plants
- Industrial sector needs development

DENMARK, MARKET POTENTIAL

- Municipal Cogen plants
  - Generation 15 TWh
  - 39 % of generation
  - 47 % of municipal consumption (32 TWh)
  - 200 MW potential to 50 % market share
- Industrial Cogen plants
  - Generation 1.3 TWh
  - 3 % of generation
  - 13 % of industrial consumption (10 TWh)
  - 740 MWe potential to 50 % market share

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GERMANY, TODAY

- High electricity prices (at 10 GWh)
  - 50-78 E/MWh with taxes and transfer costs
- Fossil fuels have small energy taxes
- Cogen plants have no energy taxes

GERMANY, MARKET POTENTIAL

- Municipal Cogen plants
  - Generation 27 TWh
  - 5 % of generation
  - 10 % of municipal consumption (279 TWh)
  - 11.000 MW potential to 30 % market share
- Industrial Cogen plants
  - Generation 31 TWh
  - 6 % of generation
  - 14 % of industrial consumption (228 TWh)
  - 17.000 MWe potential to 50 % market share

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OECD EUROPE, TODAY

- Electricity prices will stabilize
  - to about 40 E/MWh with taxes and transfer costs (10 GWh user)
  - separate transfer tariffs coming = 20 E/MWh
- Fossil fuels will have higher energy taxes
- Cogen plants will have no energy taxes

OECD EUROPE, MARKET POTENTIAL

- Municipal Cogen plants
  - Generation 100 TWh
  - 4 % of generation
  - 7 % of municipal consumption (1515 TWh)
  - 70.000 MWe potential to 30 % share
- Industrial Cogen plants
  - Generation 150 TWh
  - 6 % of generation
  - 15 % of industrial consumption (1009 TWh)
  - 70.000 MWe potential to 50 % market share

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European Power Plants in Future

Today	**No**
– > 100 MWe	2.000
– 1 -100 MWe	10.000
– 0.1 - 1 MWe	100.000
– 0 - 0.1 MWe	200.000
– ----------	
– Total	312.000
	620.000 MWe
– Average size 2 MWe	

In Future	**No**
– > 100 MWe	3.000
– 1-100 MWe	20.000
– 0.1- 1 MWe	300.000
– 0 - 0.1MWe	1000.000
– ----------	
– Total	1323.000
	1000.000 MWe
– Average size	0,8 MWe

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New European Capacity Needed within 30 years

> 100 MWe	1.000	= 200.000 MWe
1 - 100 MWe	10.000	= 100.000 MWe
0.1 - 1 MWe	200.000	= 50.000 MWe
0 - 0.1 MWe	800.000	= 30.000 MWe
Total	1 milj	380.000 MWe
Average size		380 kWe

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ACTIONS NEEDED

- Vendors — New small size plants
- New Fuels — Natural gas networks, Methanol, Bio-oils, Bio gas
- Taxes — CO2-taxes to fuels
- Policy — Cogeneration to preferred position
- Marketers — New players needed

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SUMMARY

- Cogen is the most economical because of
  - Higher electricity prices = energy(20)+t&d (20)
  - Heat revenues (20 E/MWh)
- Cogen will have 30 - 50 % market share
  - 50 % in Nordic countries, 30 % in South
  - Smaller plant sizes, decentralized systems
- Future fuels are natural gas and biofuels

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